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HEAD START EVALUATION AND RESEARCH CENTER, UNIVERSITY OF KANSAS. REPORT NO. VIIA, A CASE STUDY IN ESTABLISHING A DIFFERENTIATED SPEECH RESPONSE THROUGH GENERALIZATION PROCEDURES.

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A 2-year, 8-month old boy with a language handicap was the subject of a 5-month training program which investigated the generalization of articulatory ability during and after a series of sessions aimed at correcting the boy's misarticulation of the letter "t." Before training began, three matters necessitated attention: (1) the establishment of instructional control, (2) the assessment of the boy's language behavior, and (3) the administration of a 26-word probe test. The training condition consisted of five phases interspersed with six probe tests. The training procedures were to correct the subject's misarticulation of the letter t. The probe tests were to measure the improvement and generalization of the subject's ability to articulate. Training phase five and probe tests five and six involved a change in procedure from auditory stimuli to visual stimuli. The results indicated that proper articulation of training and nontraining words ending in t increased, with some fluctuation, during the program and led to the conclusion that generalization of articulatory ability was demonstrated. (WD)

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The University of Kansas Head Start Research and Evaluation Center

VII. a.

"A Case Study in Establishing a Differentiated Speech Response Through Generalization Procedures"

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A Case Study in Establishing a Differentiated Speech Response Through Generalization Procedures[1]

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ABSTRACT

Running head: Establishing differentiated speech through generalization.

A technique for measuring generalization effects of speech training is described. This procedure requires a baseline measure followed by training-probe, training-probe, etc., sequence. The necessity for recording data during both speech training and test conditions in order to prescribe the next procedure for subjects was emphasized. Several procedures for measuring generalization were reviewed.

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A Case Study in Establishing a Differentiated Speech Response Through Generalization Procedures[1]

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That verbal behavior can be most successfully analyzed and modified under the procedures of an experimental analysis of behavior seems to be more of an established fact than an issue. The past twelve years have especially yielded evidence to support this conclusion. Such areas as: topography of vocal responses; verbal chaining; effects of punishment and deprivation; rate manipulation; stuttering; echolalia; mutism; and conditioning of infrahuman vocalizations have all been studied from an experimental analysis paradigm. (For a recent review of verbal behavior studies from an experimental analysis point of view, see Holt and Azrin, 1966.)

Studies that have shown the widest variety of verbal behavior modification procedures with children have been with austistic subjects. (i.e., Lovaas, 1966; Risley, 1966; Risley and Wolf, 1968.) All of these studies have used shaping, imitation training, fading in of new stimuli, fading out of prompts, punishment and time out from reinforcement, chaining, and differential reinforcement of other appropriate behavior incompatible with inappropriate behavior. Many of these procedures are used when the child has a "parroting" response called echolalia. When this is the case, the training is built on already acquired verbal responses. Generally the main area of concentration is on bringing these verbal responses under stimulus control.

Many of the same procedures are also used with non-echolalia, speech deficient children with the emphasis on shaping differentiated response patterns, e.g., pronouncing initial or final sounds such as "th", "v", "f", or "s". Many times this process of shaping is long and tedious with neither the therapist nor child noting possible progress beyond the actual word being shaped. Such can occur even when the therapy procedures include reinforcement. As Risley and Wolf (1968) point out therapeutic procedures on a day-to-day basis may not reveal a clearly progressing ordliness due to daily response fluctuations. However, gradual changes can be discerned when records are kept.

The following case study describes a procedure for training the final "t" sound and a method of measuring generalization to other words which also end in the final "t". By reporting this latter method, we also are stressing the necessity of gathering data during therapy. Although many therapists often hope or assume generalization will occur, it is better if a record can be produced to see if in fact it does. Further information of this type would often help decide future speech modification procedures for a child, depending on whether generalization was occuring.

Generalization as used in this study, refers to emitting one particular sound within a variety of words subsequent to training this sound within only one word. Prior to training, the sound which was shaped had been present at a very low rate. The procedure for measuring this generalization was through the use of probes.[2] For example, the baseline rate of emitting final "t" sound on words was first determined from the S's ability to imitate a list of words ending in final "t", when emitted by E. Speech modification proceeded using only one training word. During the course of training the original list of words was administered as a probe and the rate of generalization was measured by the increases of final "t" sounds when imitating these non-trained words.

METHOD

Subject

S was a 2 year-8 months old male child who was attending the University of Kansas Infant Study Laboratory. During the five-month period of this study, S was also a subject in another research project which involved shaping gross motor responses. A history of medical diagnoses and consultations indicated S exhibited slow motor development due to congenital brain damage and had not learned to walk prior to the study. His vocalizations were inarticulate and of low volume.

General Procedures

The experimental procedures were divided into four phases: 1) Establishment of instructional control; 2) Assessment of language responses; 3) Probe test baseline; 4) Auditory stimulus-vocal response training sessions with interspersed generalization probes; and 5) Visual stimuli - vocal response generalization probes with a training session interspersed.

It was necessary to establish instructional control even prior to assessing this S's language problems because it was found that his attending behavior was not well established and his responses to instructions rather delayed. It was felt that part of the reason for this lack of instructional control was due to few contingencies placed on him in the past.

Through casual observations of the S's vocal behavior, prior to the study, it was known that he was emitting several misarticulations in addition to speaking at a low volume when compared with others of his age. Because we felt it better to attempt to modify only one component of his speech pattern at a time and because we hoped to demonstrate that this one vocalization, subsequent to training, would generalize over many words, it was necessary to carry out an extensive language assessment so as to pinpoint the specific articulation errors he emitted and to choose one from these to modify.

In the auditory stimulus - vocal response condition, one cannot disassociate the training sessions from the probe sessions because of their interdependent nature. Data recorded during training sessions determined when probe sessions were instituted and data from the probe sessions, in addition to the prior training sessions, directed the choice of procedures for the next training session. Such information would not have been available if the data had not been precisely recorded, indicating the approximation value of responses S was emitting, as well as unusual pronunciations. Because all sessions, training and probe, were tape-recorded and the data subsequently analyzed from the tapes, it was possible to extract this information.

A further generalization of S's final "t" response was tested through the presentation of pictures whose labels were words with the final "t" sound. The generalization test in this case was to determine if the final "t" sounds emitted by S would maintain even though there was no opportunity for him to directly imitate E. Such a test was considered to more closely approximate the natural environmental conditions in which S would be required to emit this vocaliation.

1. Establishment of Instructional Control

Instructional control of motor behavior was established in six sessions using procedures for establishing matched-dependent, imitative behavior (Baer, et.al., 1967). E said, "Do this", and demonstrated a motor behavior for S to imitate. Small edibles, sips of juice or 45" of play with a small truck were contingent upon S matching E's demonstration. Once instructional control was established for motor behavior, E began presenting words, e.g., "Say, 'dog'", with delivery of reinforcement contingent upon any verbal utterance of S, regardless of pronunciation.

2. Assessment of Language Behavior

E presented words to S which represented most of the phonetic sounds of the English language. The stimuli were single words from a list of phonemes reported by Risley (1966), plus other words and phrases. Reinforcement was contingent upon S emitting an utterance, regardless of its approximation value. After nine assessment sessions the final "t" sound was chosen for study.

3. Probe Test Baseline

Prior to the auditory stimulus-vocal response imitative training, a baseline of S's final "t" vocalizations to a 26-word probe test was obtained. This 26-word list (all words ended in "t") was used in all subsequent probes and served as a comparison for the various training phases. Its purpose was to assess response improvement through generalization following training on other final "t" words.

4. Auditory Stimulus - Vocal Response Training and Probe Procedures

Training Phase I - This phase was instituted primarily to develop procedures appropriate to this particular S's specific misarticulations and to determine suitable reinforcers for him. Four words, "at", "cat", "hat" and "boat" were selected as training words. In the presentation of the auditory stimulus, E separated the final "t" sound from the remainder of the word. For example, E said "Ca..", S responded "Ca..", reinforcement was delivered, E said "t", S responded "t", and reinforcement was again delivered. If S did not correctly match either the first part of the word or the final "t", E would repeat the sound until an approximation of the correct vocalization was emitted by S.

Probe I - The 26-word test list was presented for a total of 98 trials, thus included two or more presentations of each word. Reinforcement was contingent upon any vocal utterance emitted subsequent to E's presentation of the probe word, regardless of its approximation value. The data resulting from this probe was used to direct the choice of procedures for the next training phase. This method of train-probe, train-probe, etc., allows the therapist to frequently test the fruitfulness of procedures and to make procedural changes that are based upon data and not casual observations of the day.

Training Phase II -- During the eight sessions of this phase only the word "cat" was used as a training word, because it was felt that one word would be a more discriminable training stimulus than four as used during Training Phase I. The vocal presentation of the training word by E was identical to that of Training Phase I. During this phase, however, E elongated her vocalization of "Ca.." to "Caaaaa..." and S emitted his "Ca" during E's presentation, adding the final "t" sound as E added it.

. Probe II - During six sessions the 26-word probe list was presented approximately three times each session. This probe was administered across several days to determine the durability of S's final "t" vocalization. During the last two days the reinforcement sechedule was changed from continuous (CRF) to variable ratio 3(VR-3). It was necessary to continue to deliver reinforcers to maintain S's responding. However, it was felt that the CRF schedule was possibly producing a satiation condition. The VR-3 reinforcement schedule was predetermined and hence non-contingent upon correct responding.

. Training Phase III - Procedures similar to those of Training Phase II were used during this phase with the exception that more stress was placed upon the final "t" sound rather than attempting to join the "Caaa" with the "t". This was done in an attempt to enhance the attending behavior of S to the final "t" sound. Toward the end of the phase S was also reinforced for close attention to E's face and for responding vocally with "t" to E's head nod subsequent to the presentation of the final "t" sound. Delivery of reinforcement was contingent upon correct responding.

Probe III -- There was only one presentation of the 26-word probe list in the session during this phase because it was noted that S was adding a second vocalization following the "t" sound which approximated "o͡o". Therefore, a fourth training phase was designed to smooth S's vocalization of the final "t" through eliminating the additional vocalization.

g. Training Phase IV -- For one session five words, ending in a final "t", were presented with the word "is" following each of them, e.g., "it is", "what is", "boat is", etc. After approximately three presentations of each of these words in combination with the word "is", the "is" was no longer presented with the words ending in final "t".

Probe IV -- There were four presentations of the 26-word list across two sessions. Reinforcement was again noncontingent on VR-3.

5. Visual Stimulus - Vocal Response Training and Probe Procedures

. Probe V -- Prior to the presentation of this probe it was necessary to obtain a set of 10 pictures to which S could respond with the appropriate label and whose labels ended in the final "t" sound. Therefore a preliminary test was administered which consisted of a group of 25 picture cards whose labels ended in "t". From this list a test set of 10 cards was chosen on the basis of S correctly naming each picture on two of three trials without E ever labeling the picture for S. The test set consisted of six words which had not been previously presented in this study (new words) and four which had (old words).

Each of the ten test cards was presented, during Probe V, until S correctly labeled the picture three times in succession. VR-3 non-contingent reinforcement was delivered during this probe. The data was recorded for the last three response only. At no time during the probe condition did E vocally label the picture in the presence of S. An analysis of Probe V indicated that for half of the new words in the test set S emitted a low percentage of the final "t" vocalization. Consequently a training session was instituted to eliminate these errors.

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Training Phase V- Three of the words to which S emitted a low percentage of final "t" vocalizations in Probe V were used for this training session. Instructions were given to be sure to say the "t" loudly prior to each of E's presentations of a picture card. Simultaneous with the presentation of the card E said the corresponding label. The number of trials on each of the words was dependent upon the S's correct response rate. There was a total of 81 trials during the entire training session. Reinforcement was contingent upon correct responses.

Probe VI- The picture test set was presented four times to S. The experimental conditions were the same as those of Probe V of this phase of the study.

RESULTS

During the establishment of instructional control, S matched 87% of the motor stimuli and 85% of the vocal stimuli. These averages are representative across the six days.

The assessment of speech revealed difficulty in pronounciation of initial "v," "l," "th" and "r" sounds along with final consonants such as "t," "r," "l" and "w". The final "t" was a more discriminable response for recording purposes; it was judged easier for initial speech training than other sounds; and finally it was a sound already in his repertoire whereas "r" and "l" were not emitted very frequently--if at all. Seventy-three words were presented to S during assessment. Each word was presented several times and in different orders.

In Figure 1 the far left column indicates that during baseline the final "t" was emitted by S 25% of the time. This baseline measure was obtained from the 26-word probe test set.

Insert Figure 1 about here

This figure represents the baseline level with which further training can be compared.

Following training of the final "t" vocalization for the training words "cat," "at," "hat," and "boat," Probe 1 was administered. The results of Probe 1 are graphed in the second column of Figure 1. The final "t" vocalization was emitted 47% of the time, representing an increase from the results of the baseline measure. However S was still emitting the final "t" to less than 50% of the test words.

Following training Phase II using the word "cat" as a training word, a series of six tests were given for Probe II. These series of six tests (over as many days) were administered to access the stability of the final "t" vocalization. No training sessions were interspersed between probe sessions. The percentage of correct responses for each of these tests are labeled tests "A" through "F", Probe II. The effects of

training with the word "cat" appear to have increased the emission of the final "t" on other words. The percentages of S's correct responding increased from the prior 47% to 91, 97, 78, 78, 66 and 80 percent across the six probe days. However, it also appears that the emission of the final "t" was not very stable across time. The range of tests extended from 66 to 97 percent correct responding and there was some indication of a steady decrease. Although in the last session of Probe II S emitted 80% correct final "t" vocalizations on the test word list, it was felt that further training should occur prior to testing generalization on visually presented stimuli.

The training sessions between Probe II and Probe III indicated a regression in S's behavior. A detailed analysis of S's behavior during these training days showed that he was responding with the final "t" sound when it was presented alone, i.e., as opposed to presenting the total word stimulus or "ca.." preceding it, approximately 90 to 99% of the time. However when "ca.." preceded the "t", the percent correct responding ranged from 0% to 36% across the 8 training days. This failure to add the final "t" to the "ca.." vocalization seemed to influence the experimenter. It is noted that out of the total stimuli presented to S in any one session the percentage of time which final "t" was presented alone in each session increased across sessions: 40%, 49%, 54%, 63%, 78%, 81%, 67%, and 75%.

Training was then stopped and Probe III was administered. The results of Probe III are depicted in Figure 1(column four). The percentage of correct final "t" vocalizations when emitting the total words on the test was 58%. This low score reflects not only the failure to emit the "t" at the end of the words but also his emitting an addetional vocalization subsequent to the final "t" which approximated "o͡o". This addition was counted as incorrect and thus lowering the Probe III percent correct responses.

A one day training procedure was carried out to eliminate the oo sound. This training was apparently effective. Probe IV resulted in 89% correct emissions of final "t". Also none of the responses on Probe IV were followed by the "o͡o" sound. Whereas half the words in Probe III were emitted with the additional vocalization.

It appears that training primarily on one word can result in generalization to similar elements in other words. It is also possible to say, that S was learning to engage in matched-dependent vocal behavior. One might question at this point whether or not S would add the final "t" to words when he did not have the vocal model immediately preceeding his response. Consequently it was decided to present a visual stimulus rather than the auditory stimulus of E's pronunciation, to assess whether or not S would pronounce the final "t" without hearing E's stimulus word.

Figure 1 (Probe V) presents S's percent of correct final "t" vocalizations within words emitted in response to visually presented pictures. The total percent correct for all 10 words, presented three times, was 74%. Of the 10 words probed, four had been considered "old(probed earlier) and six were "new" (never presented in the study before). S vocalized a final "t" on the "old" words 86% of the time and 65% of the time on the "new" words. Therefore it appears S was not dependent upon an immediately preceding model for the pronunciation of a final "t".

Since there was a difference in the final "t" productions of S between "old" and "new" words emitted to visual stimuli, three of the

"new" were used as training words for a final training session using both visual and auditory presentations of the picture stimuli. Figure 1, Probe VI, shows final "t" productions of 89% for all 10 words presented visually. For the "old" words final "t" was emitted for 82% of the trials and for the "new" words 90%. The training procedures on 3 of the new words appears to have been effective in increasing S's final "t" response from 65 to 90%.

Discussion

This study consists of a case report of speech training for a young preschool child. The design and the evaluation procedures are suggested as necessary for determining progress in speech training. Because the process of shaping differentiated vocal responses is often a long process, any procedure which can reduce this process for the therapist and subject is important. Generalization is often desired by behavior modifiers because it is a "time saving" result, i.e., the more generalization occurs within limits, the fewer responses must be shaped. However, unless procedures are used for measuring generalization, then unnecessary training may be continued. It is also necessary to know if generalization does occur following training. If it does not, the training sessions are limited unless training for generalization follows.

The data show a fairly orderly and rather immediate increase in this S's final "t" response to non-trained test words. By the beginning of Probe IL it appears the training procedures with "cat" were effective in generalizing to other words ending in the final "t".

However, as is often the case in many therapeutic disciplines the subject does not always maintain the progress he has previously demonstrated. The fairly steady decrease in responses across Probe II sessions can only be speculated upon since no definitive manipulations were used to analyze the decrease. Such analysis was not possible since the reason for the prolonged probe was to test the durability of the response over time without intervening training. The speculations which appear most plausable, for the decline in final "t" responses to non-trained words, include a loss of reinforcer control due perhaps to satiation or the delivery of reinforcers for not adding the final "t" as well as adding it occurred, thus increasing the probability that the final "t" would not be emitted on CRF regardless of topography. Support for the above was seen in the subsequent training sessions when S was not adding the final "t" to the training word as frequently as he had previously.

A recent study by Sailor, Guess, and Rutherford (1967) indicates that manipulation of the difficulty of stimuli in verbal training sessions can control a subjects desruptive behavior. That is, if disruptive behavior is followed by difficult stimuli, disruptive behavior decreases and vice versa. This study also suggests that it is possible for a subject to control the presentation of stimuli by E. When S was not responding with the final "t" during Training Phase III, E increased the frequency of single "t" stimulus presentations in relation to presenting the total words (cat) with the final "t" ending. It is possible that S was able to control the experimental sessions at this time by not responding successfully and hence being presented with the simpler stimulus.

It is possible that the concentrated work on "t" during Training Phase III resulted in the additional "oo" response at the end of the word during Probe IV. The procedure of adding "is" to the words that ended in "t" during the fourth training session reflects a technique used by behavior modifiers for getting rid of unwanted behavior. In this instance an incompatable response (the emission of "is") was reinforced in place of "oo." Once the incompatible response was established, the undesired response was discontinued and just the desired word with the final "t" vocalized correctly.

The use of visual stimuli at the end of the study was an attempt to measure the durability of the response in conditions even further removed from the training procedures than Probes I-IV. That is, the "fragility" of the response was further tested under other generalization conditions. It is possible that adding the final "t" to non-trained words was mainly under control of the experimental procedures. The use of visually presented stimuli more closely approaches what might be the situation in "every day" conversation. When it is impossible to take data on a subject's natural language behavior, then a procedure similar to the above would seem advisable to test generalization within stimulus conditions further along the generalization continuum of similarity to the original training procedures. Of course the most desirable final procedure would be to obtain genealization samples within the subject's natural environment.

FOOTNOTES

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Fig.1 Percentages of Correct Final "t" Responses During Probe Conditions